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Original article

Intention and automaticity toward physical and sedentary screen-based leisure activities in adolescents: A profile perspective

Gonzalo Marchant [a,b,†], Guillaume Chevance [a,c,†], Julie Boiché [a,*]

[a] *Laboratory Epsylon "Dynamics of Human Abilities and Health Behavior" (EA 4556), University of Montpellier, 4 Boulevard Henri IV, Montpellier 34000, France*
[b] *Laboratory L-ViS (EA 7428), University Claude Bernard Lyon 1, Bâtiment R. Dubois - 27–29 bd du 11 novembre 1918, Villeurbanne cedex 69622, France*
[c] *Clinique du Souffle LaVallonie, 5 Santé Group, 800, Avenue Joseph Vallot, Lodève 34700, France*

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Abstract

Purpose: Physical activity (PA) and sedentary behavior (SB) are increasingly considered independent health behaviors. Additionally, current research suggests that both controlled and automatic determinants account for their adoption. The purpose of this article is to identify intention–automaticity profiles toward PA and screen-based SB and to examine how those profiles are associated with different behavioral patterns.
Method: Two cross-sectional studies based on self-report questionnaires were conducted with French high school students (Study 1: $n = 198$; Study 2: $n = 185$).
Results: In all, 4 distinct motivational profiles appeared. The first 3 clusters emerged in both studies: "PA" (high levels of automaticity and intention for PA, low levels of automaticity and intention for screen-based SB); "screen" (high levels of automaticity and intention for screen-based SB, low levels of automaticity and intention for PA), and "mixed" (high levels of all variables), whereas the fourth cluster was observed only in Study 2: "high control" (below-mean levels of automaticity, high levels of intention toward both PA and screen-based SB). Adolescents with a screen profile displayed the least healthy behavioral pattern, whereas those in the PA profile demonstrated the most favorable behaviors.
Conclusion: Future research is needed to extend these results to other populations using complementary assessment methods of automatic psychological processes and PA and SB behaviors.

Keywords: Active lifestyle; Cluster analysis; Control; Dual process; Exercise; Habit motivation; Physical activity

1. Introduction

Increasing evidence indicates that physical activity (PA) levels in youth have declined during the past decades, with currently 4 of 5 adolescents not reaching the levels recommended in public health guidelines.[1] Meanwhile, past research also indicates that the time devoted to sedentary behavior (SB) has gradually increased over time, particularly in children and adolescents.[2] Whereas for a long time PA and SB have been regarded as functional opposites—for example, through the perspective of the "displacement hypothesis"[3]—they tend more and more to be conceived as 2 distinct categories of behaviors, which are likely to have independent effects on health.[4] In this vein, the mean durations devoted to those behaviors were previously found to be mainly independent and only marginally negatively related,[5] in particular in the case of screen-based SB and leisure-time PA. This suggests that various patterns of behaviors could exist in the population. In particular, young people could combine high levels of both PA and SB. In this regard, several authors suggest that those behaviors present at least partly distinct psychological determinants.[6]

Recently, it was advocated by health psychologists that behavior adoption relies on 2 main kinds of processes, that is, controlled processes, which imply deliberate decisions and intentions, and automatic processes, characterized by "four horsemen", namely, lack of awareness, efficiency, lack of intention, and difficulty in controlling one's behavior.[7] Automaticity

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* Corresponding author.
E-mail address: julie.boiche@umontpellier.fr (J. Boiché).
† The first two authors equally contributed to the article.

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is not conceived as an "all-or-nothing" characteristic, but psychological processes can be considered to lie on a continuum. More particularly, each process can be deemed to occur with more or less awareness on the part of the individual, to be more or less easy to control, to be more or less efficient, and to be (un)intentional, to some degree.[8] In previous research conducted on habits, it was advanced that individuals are unlikely to be aware of some of the processes of engaging in a health-related behavior,[9] even when the behavior is characterized as being fully conscious.[10] However, meta-cognitive instruments can be used based on the assumption that people are able to reflect the other features of automaticity—that is, lack of intention, control, and attention, particularly for exercise.[11]

Among controlled processes, intentions have been established as the strongest construct associated with PA in adolescents.[12] In the past decades, several studies investigated this relationship, in particular based on the theory of planned behavior.[13] In 2002, the results of 72 studies were pooled in a meta-analysis, which supported the tenets of the theory of planned behavior in the case of PA (i.e., intentions mediate the relationships between attitudes, social norms, perceived behavioral control, and behavior adoption; perceived behavioral control also has a direct relationship with behavior).[14] A more recent meta-analysis confirms that intentions are significantly associated with PA behavior, controlling for perceived behavioral control and past PA behavior.[15] Even if SB were less studied, a handful of studies also indicated that intentions to adopt various SBs, including TV watching, are significantly associated with the time spent doing them.[16] Recently, health psychologists were compelled to simultaneously consider controlled and automatic processes.[17] Indeed, behaviors need to be repeated to have significant effects on health, which is particularly relevant in the case of PA. In other words, health-related behaviors are deemed more beneficial when they become habits. Whereas assessing the frequency of behavior was long considered the best strategy to capture habits, a more contemporary view proposes to consider this construct as a repeated behavior that has gained a degree of automaticity and is executed in stable contexts.[11]

Numerous investigations of the role played by the automatic properties involved in habitual behavior were conducted in the past decade, thanks to the development of self-report scales to capture automatic processes, in particular the Self-Report Habit Index (SRHI).[18] A recent meta-analysis examined the links between habit strength and health behavior adoption, including PA and SB.[19] It revealed the existence of medium to strong correlations between habit strength and behavior adoption. It also supported the theory that the contribution of intentions and automaticity levels in the explanation of PA and SB operated in interaction. More precisely, intentions tend to show lower associations with behavior when habit levels are high, and vice versa. Furthermore, past research suggested that automaticity toward one behavior may affect not only the frequency of its adoption but also individuals' engagement in other behaviors.[20] More precisely, it was observed that a strong habit toward television viewing was positively associated with soft drink consumption. Automatic processes could thus be seen as potential predictors of a pattern of interconnected behaviors rather than the determinants of a single, separated action.

In summary, it seems that both intentional and automatic psychological processes are worthy of consideration when trying to understand the adoption of health-related behaviors such as PA and SB. Additionally, there is increasing evidence that those categories of behavior are partly independent, but it was also advanced that they could share common determinants. In particular, it is possible that the psychological dispositions toward one kind of behavior could affect a different category of behavior. In other words, cross-context correlations should be expected (i.e., between motivational determinants of PA with SB, and vice versa). Considering those complex assumptions, the current research adopted a person-centered approach. More specifically, the purposes of the present study were (1) to identify intention–automaticity profiles toward PA and screen-based SB in adolescents and (2) to examine how those profiles were associated with the adoption of significantly different behavioral patterns in terms of PA and screen-based SB.

2. Study 1

2.1. Methods

2.1.1. Participants and procedure

A cross-sectional design was conducted for 198 Grade 10 students (108 females, 70 males, and 20 students who did not provide gender) from a general French high school (age range 14–20 years; 16.00 ± 0.76, mean ± SD). The study protocol was in accordance with the principles of the Declaration of Helsinki of 1975, as revised in 2000. It was approved by the Ethics Committee research team at the University of Montpellier, France. All participants signed the informed consent presenting the purpose of the study, which indicated that their participation was voluntary and that they could cease it at any time. They were assured that confidentiality would prevail during the whole study and that only the means of the participants would be analyzed and communicated. Questionnaire completion occurred during a compulsory physical education lesson supervised by a teacher and lasted about 15 min.

2.1.2. Measures

2.1.2.1. PA. The International Physical Activity Questionnaire was used.[21] The participants were asked to indicate (1) how many days they engaged in at least 10 min of vigorous PA, moderate PA, and walking during the previous week, and (2) the average duration of those sessions. The International Physical Activity Questionnaire has acceptable measurement properties for monitoring levels of habitual PA in male and female adolescents older than 14 years.[22]

2.1.2.2. Screen-based SB. The time spent by participants watching TV or using a computer was assessed by means of the corresponding 2 items of the Sedentary Behavior Questionnaire,[23] distinct questions having been formulated regarding weekdays and weekends. The total amount of time per week was computed by multiplying the number of days in which they adopted such behaviors by the average duration of those sessions. The

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2-week reliability and validity of those items was demonstrated in adults,[23] and they were successfully used in previous research among high school students.[24]

2.1.2.3. Automaticity. Automaticity toward PA and SB was measured with the Self-Report Behavioral Automaticity Index (SRBAI).[25] Following the stem "*Behavior X is something. . .,*" this 4-item scale ("*that I do without thinking*"; "*that I do automatically*"; "*that I do without having to consciously remember*"; "*that I start doing before realizing I am doing it*") includes a Likert scale ranging from 1 (*do not agree at all*) to 5 (*totally agree*). Internal consistency was high for both PA ($\alpha = 0.80$) and screen-based SB ($\alpha = 0.80$).

2.1.2.4. Intentions. Intentions were measured with 2 items ("Do you have the intention to practice regular physical activity, watch TV, or use a computer regularly during the upcoming week?"; "Are you sure to practice regular physical activity, watch TV, or use a computer regularly during the upcoming week?"). Participants answered on a 5-point bipolar scale ranging from −2 (*no, not at all*) to +2 (*yes, absolutely*). Internal consistency was high for both behaviors (PA, $\alpha = 0.85$; screen-based SB, $\alpha = 0.90$).

2.1.3. Data analysis

Regarding items for which less than 5% of data were missing, a replacement by the mean score was applied ($n = 45$).[26] Complete data were available for 147 participants. To reach the study's first objective, a series of cluster analyses were conducted to create groups of participants according to their intention and automaticity profiles. To avoid distortion in the formation of clusters, particular attention should be paid to metrics, outliers, and multicollinearity.[27] After these prerequisites were verified, a hierarchical cluster analysis was performed to explore the number of clusters that naturally emerge, using Ward's method as algorithm and squared Euclidean distance as similarity measure. The obtained centroids' characteristics were then used in a confirmatory k-mean cluster analysis with a defined number of clusters. Next, ANOVAs were conducted to test the intercluster differences in terms of automaticity and intention. Last, a series of ANOVAs was performed to observe potential differences between clusters in terms of behavior adoption.

2.2. Results

2.2.1. Descriptive statistics

Correlations between the variables appear in Table 1. A correlation for the data revealed that intentions and automaticity scores were significantly but not highly related ($r = 0.56$, $r = 0.42$ for PA and screen-based SB, respectively, $p < 0.05$). PA intentions and automaticity were significantly associated with high and moderate intensity PA ($0.27 \leq r_s \leq 0.49$, $p_s < 0.05$) but not with walking ($r = 0.05$, $r = 0.10$, respectively, $p > 0.05$). Screen-basd SB intentions and automaticity were significantly correlated to the time spent in front of a screen ($r = 0.29$, $r = 0.44$, respectively, $p < 0.05$). Last, cross-context correlations (i.e., between motivational determinants of PA and screen-based SB, or vice versa) were nonsignificant or low. For instance, the higher the level of PA automaticity in participants, the lower their intentions to spend time in front of a television or a computer ($r = -0.27$, $p < 0.05$).

2.2.2. Prerequisites to cluster analysis

The mean ± SD values for each variable of the study appear in Table 2. The variables included in the cluster analysis were standardized so as to contribute equally to the formation of the clusters.[27] Five univariate outliers were excluded from further analysis (distance from the mean superior to 3.29SD units), as well as 6 multivariate outliers (Mahalanobis distance significant at the $p = 0.001$ threshold). Finally, because the highest correlation was equal to $r = 0.51$, no problem of multicollinearity was encountered.

2.2.3. Cluster analysis

A hierarchical cluster analysis was performed entering intention and automaticity toward PA and SB. A large increase of the agglomeration coefficient (29%) suggested a 3-cluster solution to be suitable. This analysis was followed by a confirmatory k-mean cluster analysis. The centroids' characteristics appear in Table 2, and Fig. 1A describes the 3 intention–automaticity profiles. The first cluster was labeled "screen",

Table 1
Correlation coefficients for Studies 1 and 2.

	1	2	3	4	5	6	7	8
Physical activity								
1. Intention	—	0.54*	0.57*	0.28*	0.01	−0.22*	−0.28*	−0.40*
2. Automaticity/lack of control	**0.56***	—	0.40*	0.22*	0.00	−0.31*	−0.07	−0.33*
3. High intensity	**0.48***	**0.49***	—	0.12	−0.08	−0.27*	−0.12	−0.24
4. Moderate intensity	**0.33***	**0.27***	**0.24***	—	0.23*	−0.01	−0.05	−0.09
5. Walking	**0.05**	**0.10**	**0.16**	**−0.07**	—	−0.04	0.06	0.10
Sedentary behavior								
6. Intention	**−0.17**	**−0.27***	**−0.01**	**0.02**	**0.09**	—	0.29*	0.51*
7. Automaticity/lack of control	**0.06**	**−0.02**	**−0.10**	**0.01**	**−0.01**	**0.42***	—	0.37*
8. Screen-based time	**0.15**	**−0.03**	**0.16**	**0.14**	**0.05**	**0.29***	**0.44***	—

Note: Correaltion coefficients for Study 1 are relected in bold, the others are Study 2.
* Correlation is significant at the $p < 0.05$ level.

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Table 2
Mean value and centroid characteristics of intention and automaticity for PA and SB (Study 1, mean ± SD).

	All $n = 136$	Mixed $n = 49$ (36%)	Screen $n = 54$ (40%)	PA $n = 33$ (24%)	F	η^2	p
PA							
Intention	0.86 ± 1.10	1.71 ± 0.48	0.07 ± 0.95*	1.06 ± 0.77*#	59.39	0.47	0.000
Automaticity	2.95 ± 1.08	3.65 ± 0.80	2.04 ± 0.68	3.30 ± 0.76*#	66.07	0.50	0.000
High intensity	192.81 ± 199.58	343.51 ± 229.23	78.61 ± 103.99*	213.20 ± 142.96*#	26.85	0.34	0.000
Moderate intensity	93.65 ± 159.87	127.67 ± 203.46	36.07 ± 55.03*	102.30 ± 97.16*#	4.79	0.08	0.010
Walking	203.23 ± 243.47	236.01 ± 303.46	140.97 ± 113.04	212.50 ± 193.60	2.16	0.04	0.120
SB							
Intention	1.18 ± 0.98	1.62 ± 0.53	1.65 ± 0.42	0.63 ± 0.67*#	44.99	0.40	0.000
Automaticity/LOC	3.05 ± 1.10	3.67 ± 0.84	3.36 ± 0.97	1.98 ± 0.46*#	44.89	0.40	0.000
Screen-based time	505.30 ± 403.97	666.34 ± 454.78	534.75 ± 379.07	383.89 ± 271.53*#	4.35	0.08	0.015

Note: $n = 136$, only 136 participants provided complete data on their behaviors.
* $p < 0.05$, compared with mixed group; # $p < 0.05$, compared with screen group.
Abbreviations: LOC = lack of control; PA = physical activity; SB = sedentary behavior.

because students in this group were characterized by high levels of automaticity and intention for screen-based SB, but low levels of automaticity and intention for PA. It comprised 40% of the sample ($n = 54$). The second cluster was labeled "PA" and was characterized by high levels of automaticity and intention for PA, but low levels of automaticity and intention for screen-based SB. It included 24% of the sample ($n = 33$). The third cluster, characterized by high levels of all variables, was labeled "mixed" and comprised 36% of the sample ($n = 49$).

A series of ANOVAs indicated significant differences among clusters regarding all psychological variables (Table 2). Newman-Keuls *post hoc* analyses indicated that the 3 groups were significantly distinct from each other on PA intentions ($p < 0.05$). However, regarding automaticity toward PA and intention and automaticity toward screen-based SB only the "PA" group obtained significantly different scores compared to the other 2 profiles.

2.2.4. Clusters characteristics

A series of ANOVAs indicated significant between-cluster differences regarding PA and screen-based SB. Participants in the mixed profile displayed significantly higher levels of vigorous PA, followed by those with the PA and the screen cluster. Participants with a screen profile also reported significantly lower levels of moderate-intensity PA compared with the other profiles. No statistical difference emerged regarding walking. Finally, participants in the mixed cluster reported the highest durations of screen-based SB, whereas those in the PA cluster showed the lowest scores.

3. Study 2

3.1. Methods

Study 2 concerned 185 students (59 females; 126 males) recruited from Grades 9 to 12 of a general French high school (age range 14–19 years; 17.00 ± 0.83, mean ± SD). The protocol, method, and data analysis strategies were similar to Study 1, with the exception of the measurement of automaticity. Three items assessing lack of control (LOC) were derived from the SRHI.[18] A discriminant validity study indicates that the 4 items of the SRBAI fail to capture this facet of automaticity,

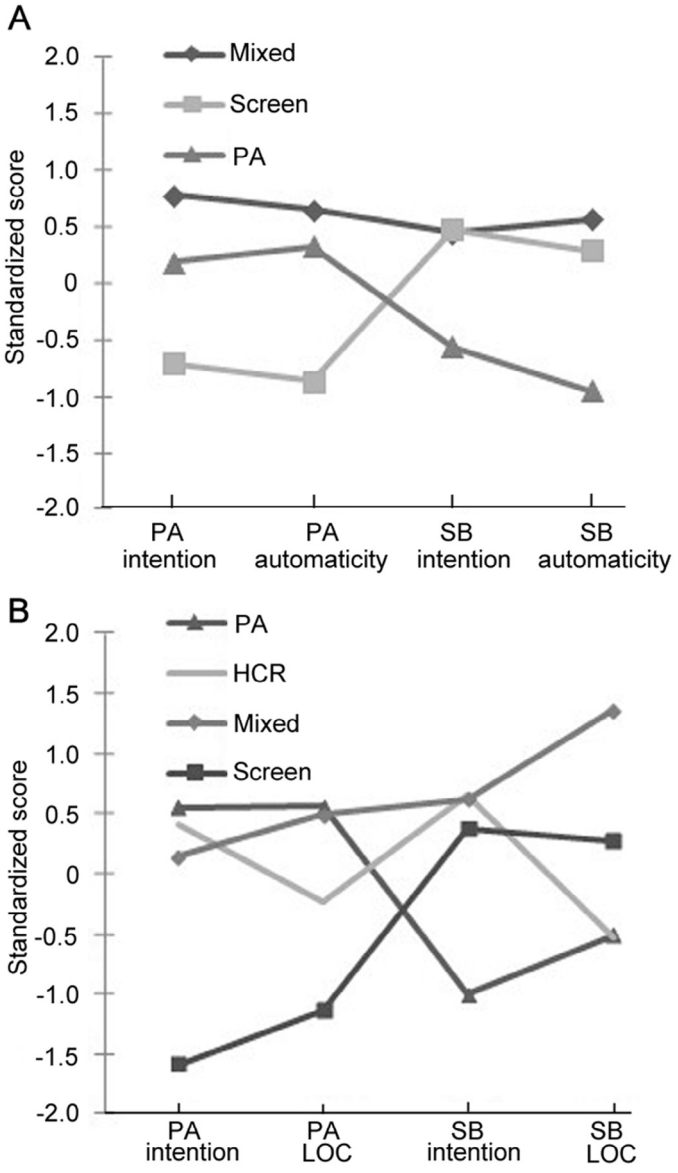

Fig. 1. Intention–automaticity profiles (Study 1, A) and intention–lack of control profiles (Study 2, B) observed among secondary school students. HCR = high control profile; mixed = mixed profile; LOC = lack of control; PA = physical activity; SB = sedentary behavior; screen = screen profile.

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contrary to those 3 SRHI items.[28] Following the stem "*Behavior X is something I do. . .*," participants used a 5-point Likert scale ranging from 1 (*totally not agree*) to 5 (*totally agree*) to characterize 3 affirmations ("*that makes me feel weird if I do not do it*"; "*that would require effort not do it*"; "*that I would find hard not to do*"). Internal consistency was satisfactory for all scales ($0.72 < \alpha < 0.93$). Regarding items for which less than 5% of data were missing, a replacement by the mean score was applied ($n = 23$).[26]

3.2. Results

3.2.1. Descriptive statistics

Correlations between the variables appear in Table 1. There was a significant correlation among PA intention, PA LOC, and high intensity PA ($r = 0.57$, and $r = 0.40$, respectively, $p < 0.05$), as well as with moderate PA ($r = 0.28$, and $r = 0.22$, respectively, $p < 0.05$), but not walking. There was also significant correlations between SB intentions and LOC and screen-based time ($r = 0.51$ and $r = 0.37$, respectively, $p < 0.05$).

A significant, but small, negative association between PA intention and SB intention was observed ($r = -0.22$, $p < 0.05$). Negative associations between PA intention and LOC and screen-based time were also observed ($r = -0.40$ and $r = -0.33$ respectively, $p < 0.05$). Last, there was a negative correlation between SB intentions and intense PA ($r = -0.33$, $p < 0.05$).

3.2.2. Prerequisites to cluster analysis

The mean ± SD values for each variable appear in Table 3. The variables were standardized so as to contribute equally to the formation of the clusters.[27] No univariate outliers (distance from the mean superior to 3.29SD units) were observed, but 1 multivariate outlier (Mahalanobis distance significant at the $p = 0.001$ threshold) was excluded. No problems of multicollinearity were encountered (highest correlation: $r = 0.51$).

3.2.3. Cluster analysis

A hierarchical cluster analysis was performed entering intention and LOC toward PA and screen-based SB. A large increase of the agglomeration coefficient (26%) suggested that a 4-cluster solution was suitable. A confirmatory k-mean cluster analysis was run. The centroids' characteristics appear in Table 3, and Fig. 1B describes the 4 intention–LOC profiles.

Three clusters presented similar characteristics to those observed in Study 1, namely a "PA" profile ($n = 65$, 34%), a "screen" profile ($n = 37$, 20%), and a "mixed" profile ($n = 36$, 20%). The fourth cluster was labeled "high control" because participants in this group displayed below-mean levels of LOC, but high levels of intentions toward both PA and screen-based SB ($n = 46$, 26%).

A series of ANOVAs indicated significant differences between clusters for all psychological variables (Table 3). Newman-Keuls *post hoc* analyses indicated that the 4 groups were significantly distinct from each other on LOC toward PA, except between the PA and mixed profiles, and on LOC toward screen-based SB, except between the PA and the high control profiles. Regarding intention toward PA, the screen profile did not differ significantly from the other groups. Last, regarding intention toward screen-based SB, only the PA profile was significantly different from the others.

3.2.4. Cluster characteristics

A series of ANOVAs indicated significant between-cluster differences regarding PA and screen-based SB (Table 3). Newman-Keuls *post hoc* analyses indicated that participants in the screen group reported significantly lower levels of vigorous PA compared with the other profiles. No significant difference emerged regarding moderate PA or walking. Participants in the PA profile showed significantly lower levels of screen-based SB compared with the other groups.

4. Discussion

The purpose of this article was to identify intention–automaticity profiles with regard to PA and screen-based SB and to examine whether those profiles were associated with significantly different behavioral patterns in French adolescents. Study 1 underlined the presence of 3 motivational profiles: a screen and a PA cluster, characterized by high levels of both intentions and automaticity for one behavior (SB/PA) and low levels of those variables for the alternative (PA/SB), and a mixed cluster with high levels of both controlled and automatic

Table 3
Mean value and centroid characteristics of intention and automaticity for PA and SB (Study 2, mean ± SD).

	All $n = 184$	PA $n = 65$ (34%)	High control $n = 46$ (26%)	Mixed $n = 36$ (20%)	Screen $n = 37$ (20%)	F	η^2	p
PA								
Intention	0.395 ± 1.24	4.62 ± 0.59	4.45 ± 0.65	4.12 ± 0.92	1.96 ± 0.80	119.08	0.66	0.000
LOC	2.89 ± 1.18	3.54 ± 0.51	2.60 ± 1.00*	3.47 ± 0.83#	1.53 ± 0.68*#†	47.93	0.44	0.000
High intensity	289.24 ± 289.25	411.10 ± 320.89	298.48 ± 250.96	315.61 ± 277.27	60.67 ± 104.46*#†	13.84	0.19	0.000
Moderate intensity	118.26 ± 195.89	139.31 ± 197.14	140.37 ± 252.76	122.97 ± 182.59	45.90 ± 56.20	1.96	0.03	0.122
Walking	285.67 ± 360.24	331.12 ± 424.23	259.88 ± 340.97	229.50 ± 216.27	290.63 ± 371.62	0.62	0.01	0.601
SB								
Intention	3.70 ± 1.19	2.48 ± 0.78	4.46 ± 0.56*	4.43 ± 0.75*	4.13 ± 1.01*	82.39	0.58	0.000
LOC	1.97 ± 1.05	1.42 ± 0.51	1.41 ± 0.47	3.42 ± 0.55*#	2.25 ± 1.26*#†	73.81	0.55	0.000
Screen-based time	789.20 ± 77.03	375.35 ± 232.34	832.67 ± 695.64*	1057.83 ± 832.09*	1267.33 ± 1059.005*	13.10	0.20	0.000

Note: $n = 184$, only 184 participants provided data on their behaviors.
* $p < 0.05$, compared with PA group; # $p < 0.05$, compared with high control group; † $p < 0.05$, compared with mixed group.
Abbreviations: LOC = lack of control; PA = physical activity; SB = sedentary behavior.

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forms of motivations for both behaviors. Those profiles were also observed in Study 2, as well as a high control cluster characterized by high levels of intentions but low levels of LOC. Those results highlight the interest in studying the components of automaticity in health psychology, in particular pertaining to PA and SB. Indeed, recent work indicates that the 4-item SRBAI mainly reflects the unintentional initiation and efficient realization of behavior, whereas the 3 items of the original SRHI retained in Study 2 mostly reflect the LOC facet. The results also highlight the great consistency that appears in most adolescents between intentional and nonintentional processes. However, the correlation values between intention and automaticity scores suggest that automaticity is not all-or-nothing, but rather that intentions and automaticity can coexist. In other words, the results indicate that automaticity may not be a firm dichotomy, suggesting the existence of a continuum where the attributes of automaticity can develop gradually. Thus, if behavior initially was intentional and if intentions remain stable over time, then automaticity would correlate with intentions. In this vein, with the exception of the high control group in Study 2, adolescents apparently tend to form intentions to adopt behaviors for which they also report strong levels of automaticity.

The present work further provides evidence relative to the differentiated patterns of behaviors observed depending on adolescents' motivational profiles. Based on the observed correlations, the current set of studies confirms that both intentions and automaticity levels toward 1 type of behavior are strongly associated with its adoption. Additionally, small correlations were obtained between PA and SB scores. On the one hand, the direction of these associations is consistent with the displacement hypothesis;[3] on the other hand, their small magnitude does not support the existence of a full substitution phenomenon, highlighting the interest in studying both behaviors independently.[5] Indeed, this result suggests that some individuals can be at the same time sedentary and physically inactive or can present with simultaneously high PA and high sedentary time.[29] There were also several significant and negative cross-correlations between psychological processes (intention or automaticity/LOC) toward one behavior and the adoption of the other behavior. Thus, PA and screen-based SB share to a certain extent some common motivational determinants.

Regarding the results relative to the association between motivational profiles and behaviors, Studies 1 and 2 revealed only partly similar patterns for PA. Indeed, whereas in Study 1 the mixed profile was attached to higher levels of intense and moderate PA, in Study 2, students in the PA profile appeared to be the most active. Both studies indicated that the screen profile demonstrated the lowest levels of PA. It is noteworthy that no significant differences emerged for walking, suggesting that motivational profile mostly accounts for more intense PA. Regarding SB, the results consistently showed that adolescents with a screen profile spent the greatest amounts of time in this behavior, whereas those with a PA profile spent the least. Displaying a mixed or high control profile was associated with intermediate levels of SB. Ultimately, a PA profile appears to be associated with the healthiest behavioral pattern. On the other hand, participants with a mixed profile were found to be active but at the same time sedentary. These findings extend arguments that both types of motivation can be useful for explaining health behaviors, especially when automatic and controlled processes are expected to have separate mechanisms of behavioral regulation. These systems are inevitably intertwined as they regulate behavior.

The results were not exactly similar in both studies regarding correlations, profiles, or association between profiles and behaviors. Several explanations may be advanced to account for those slightly different results. First, Study 1 and Study 2 differed in terms of participants, with Study 2 including a wider range of grades. Because PA participation was previously found to decrease and sedentary time to increase with age in adolescents,[1] this could account for varying results. Second, different items were used to evaluate automaticity, and Study 1 and Study 2 focused on different features of this construct.[30] This could explain why standardized scores were slightly different for the mixed profiles between both studies and why a fourth profile emerged.

The current research supports the interest in a joint assessment of intention and automaticity for both PA and SB in adolescents. In line with recent research,[5] it appears that various combinations of behaviors can be observed in youth, and knowing that an adolescent has adopted one behavior does not enable the reaching of conclusions on his or her involvement in the other. The present findings are, however, limited by several factors. A first limitation relies in the cross-sectional design. It would be interesting to conduct prospective studies to investigate whether intention–automaticity profile explains the PA and SB behaviors subsequently adopted. Another limitation is linked to the use of self-reported measurement, regarding both automaticity and behavior. Regarding automatic processes, recent debates occurred in the health psychology community regarding the nature of the processes actually captured by scales such as the SRHI or SRBAI.[31,32] Indeed, this method implies meta-cognitive processes that cannot be considered purely automatic, and, in particular, it was advocated that individuals could not be expected to be able to recall phenomena occurring outside their consciousness. Some authors thus recommended the use of implicit tests, such as the implicit-association test or a "go–no go" task, to capture automatic processes, in the sense of their being out of one's awareness.[33]

Regarding PA and SB, individuals are likely to overestimate the time that they spend being active or, to the contrary, to underestimate the time that they spend watching TV or using a computer. In this regard, the use of objective assessment devices represents a fruitful research perspective. Indeed, devices such as accelerometers are increasingly being used to help young people estimate their actual energy expenditure.[34] Intentional processes are also likely to predict structured activities, whereas automatic processes would account to a greater extent for spontaneous behaviors.[35] Such a hypothesis could be explored in studies combining explicit self-reported measures, with objective indicators of behavior.

In terms of research perspectives, future studies should investigate intention–automaticity profiles in different age groups,

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because both the profiles and the patterns of behaviors attached to them could differ among adolescents (younger and older), adults (depending on their working and family status), and older people. Particular attention should be paid to different cultures to examine whether the current results can be generalized. Finally, in a more applied perspective, the study of these different psychological and behavioral profiles offers at least 2 new perspectives. First, specific interventions targeting preferentially controlled or automatic processes were recently proposed.[36,37] It would be interesting to examine whether the efficacy of these interventions regarding behavior varies depending on the participants' motivational profile. Second, there is increasing evidence relative to the importance of considering behavioral change interventions for PA and SB in an independent fashion.[38] Considering the distinct nature of these behaviors, it could be fruitful to examine whether the efficacy of an intervention targeting controlled or automatic processes differs for PA and SB.[39]

5. Conclusion

In this set of studies 4 disctint profiles emerged regarding the combination of PA and screen-based SB motivation in French adolescents. This result highlights the fact that individuals may display more or less high levels of intentions and/or automaticity toward these behaviors. The data further indicate that their adoption is rather independent. The healthiest behavioral pattern was displayed by those with a PA motivational profile, characterized by high levels of motivation toward PA but low toward screen-based SB, whereas the poorest was demonstrated by adolescents with the Screen profile, showing reverse characteristics. Future research should seek to replicate these findings, taking into account the type of behaviors adopted-structured or spontaneous-using both self-reported and objective measurement, and exploring whether the results differ according to age or culture. In a translational perspective, the response of individuals displaying various motivational profiles to interventions targeting preferentially intentional or automatic motivation toward PA and/or both SB could be investigated.

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Authors' contributions

GM drafted the manuscript; GC performed the statistical analysis and drafted the manuscript; JB conceived of the study, participated in its design and coordination and helped drafting the manuscript. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Competing interests

None of the authors declare competing financial interests.

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